

DANGER FROM CARBON MONOXIDE IN THE HOME

BY L. B. BERGER AND H. H. SCHRENK

* * * * * Information Circular 7676



UNITED STATES DEPARTMENT OF THE INTERIOR

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BUREAU OF MINES

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Work on manuscript completed November 1953. The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is made: "Reprinted from Bureau of Mines Information Circular 7676."

February 1954

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INTRODUCTION

This information circular is a revision of I.C. 7238, Danger from Carbon Monoxide in the Home, by L. B. Berger and H. H. Schrenk, issued in April 1943.

Each winter brings its toll of deaths and serious accidents from the deadly gas, carbon monoxide. Newspapers carry warnings to the public of the dangers of this gas, and frequent news items report the finding of persons dead or unconscious from the effects of carbon monoxide, yet these accidents continue. Either these warnings are not read, or they are unheeded by people who feel that, "It can't happen to me." It can happen to you - carbon monoxide is no respecter of persons.

Carbon monoxide has been a threat to human safety as long as man has used fire to keep himself warm and to cook his food. The burning of any fuel that contains carbon may produce carbon monoxide. This is true of solid fuels, such as coal, coke, and wood; of liquid fuels, such as oil, gasoline, and kerosine; and of gaseous fuels, such as natural or manufactured gas. In the process of combustion the carbon in the fuel unites chemically with the oxygen of the air to form carbon dioxide (CO_2), but if the supply of air is inadequate, combustion will be incomplete, and carbon monoxide (CO) will be formed.

It is evident that any fuel-burning heating appliance may be a source of carbon monoxide unless it is adjusted and operated properly.

The numerous accidents caused by carbon monoxide are unquestionable evidence that many unsafe heating appliances are being used, and therefore the individual user should give due consideration to the condition of the various heating devices in his own household.

The purpose of this publication is to emphasize the dangers of carbon monoxide and to suggest safeguards against this hazard of everyday life.

PROPERTIES OF CARBON MONOXIDE

Carbon monoxide is a colorless, odorless, and tasteless gas and therefore gives no warning of its presence. A heating appliance that is producing carbon monoxide may or may not give off some other material that is odorous or irritating; therefore, one should never depend on the sense of smell to judge whether a heating device is operating properly.

Carbon monoxide burns in air with a blue flame, uniting with the oxygen of the air to form carbon dioxide. The blue flames visible above a bed of hot coals in a grate are caused by carbon monoxide burning in the air above the coals. If this supply of air were shut off, the carbon monoxide would escape unburned. Carbon monoxide does not combine chemically with air at ordinary temperatures.

Carbon monoxide is slightly lighter than air, but one should not assume that for this reason carbon monoxide will rise to the upper parts of a room or other enclosed space. Any part of an enclosure in which carbon monoxide is produced is unsafe, for the gas will diffuse and mix with the air in all parts of the space, and once it is mixed with the air, it will not separate from or stratify in the air.

ACTION OF CARBON MONOXIDE ON THE BODY

When breathed into the lungs, carbon monoxide combines with the hemoglobin (the red coloring matter) of the blood and by this action deprives the blood of its ability to carry oxygen (which is necessary to support life) from the lungs to other parts of the body. The severity of the ensuing symptoms depends on the degree to which the body is deprived of oxygen and the duration of the deprivation. This, in turn, depends on the concentration of carbon monoxide in the air breathed and the length of exposure. In other words, breathing a little carbon monoxide for a long time may produce just as serious effects as breathing a high concentration for a short time. Air containing as little as 1/100 of 1 percent (100 parts carbon monoxide in 1,000,000 parts air) of the gas may cause ill effects if breathed long enough. The first symptom of carbon monoxide poisoning is a feeling of vague discomfort and uneasiness. The skin of the forehead feels tight, and a slight headache may be noticed. As more carbon monoxide is breathed these symptoms become worse. The headache becomes severe, the victim becomes dizzy and nauseated and uncertain in his movements, his vision is impaired, and he may lapse into unconsciousness. If the unconscious person is not removed from the carbon monoxide-laden air, death may follow. If the concentration of carbon monoxide is high enough, unconsciousness may occur without warning symptoms, and sleeping persons may lapse into unconsciousness without awakening.

A person who has been revived from carbon monoxide asphyxia after a short exposure may recover without serious aftereffects other than a few hours of extreme illness. If the victim has remained unconscious in the contaminated atmosphere for a prolonged period he may never recover completely, as some effects may be permanent.

HOW ACCIDENTS ARE CAUSED BY CARBON MONOXIDE AND HOW TO PREVENT THEM

The following recommendations and precautions for the safe use of heating appliances in the home are based on experience gained by the Bureau of Mines, gas-company representatives, physicians, and others who have investigated accidents caused by carbon monoxide:

Gas-Fired Space Heaters (Gas Stoves for Heating Individual Rooms)

1. Vent gas-fired heating devices by flue connections, so that if carbon monoxide is formed it will be carried outdoors through the flue instead of being discharged indoors.

2. Always have some ventilation in a room where a gas-heating appliance is burning. Even though combustion is complete and no carbon monoxide is formed, burning gas will consume the oxygen of the air in the room. For example, each cubic foot of natural gas burned will consume the oxygen in about 10-1/2 cubic feet of air. A gas appliance properly connected through flues to the outdoors will help ventilate a room, as air will be drawn into the room to replace the gas fumes that are discharged through the flue.

3. Regulate gas-fired heating appliances that are provided with adjustable air-mixing valves so that enough air is supplied to insure complete combustion of the gas. Such adjustments are best made by representatives of gas companies or by other service agencies experienced in the use of gas appliances. If such service is not available, the adjustment may be made while the stove is burning by opening the air-admission ports of the mixing valve until the flames rise and tend to leave the burners (indicating that too much air is being mixed with the gas) and then closing the air-admission ports until the flames just return to the burners. Air-admission ports should be kept clean, as accumulations of dust will hinder entrance of air and may cause incomplete combustion and formation of carbon monoxide.

4. Do not operate a gas-heating device at an excessively high rate of burning. Many gas heaters will produce no carbon monoxide when operated at the rate for which they were designed by their manufacturers but will produce dangerous quantities of carbon monoxide if too much gas is burned. Do not attempt to get more heat from the appliance by changing the size of the orifice that admits gas to the mixing valve, as this may cause production of carbon monoxide. Do not operate heaters of the type that burn with a yellow flame so that the flames strike the metal; the cooling effect of the metal prevents complete combustion, and carbon monoxide is produced. Do not operate heaters of the radiant type so that flames extend above the radiant tiles. If a stove will not furnish enough heat when operated properly, the only safe procedure is to obtain a larger stove.

5. Do not retire for the night with a gas-heating appliance burning in the bedroom. The stove may be operating safely during the day and evening, but as many persons shut off their heating appliances during the night the pressure in the gas lines may increase between night and morning, with the result that a heater left burning all night will operate at a dangerously high rate of burning, and carbon monoxide will be produced.

6. Do not use a stove designed for natural gas to burn manufactured gas, and vice versa. Be sure that the heating appliance is designed for the kind of gas that is to be burned. Proper combustion can be obtained only when the stove is supplied with gas of the type for which it is intended.

7. Do not use rubber hose for connecting heating appliances to the gas service lines. Pipe or metal tubing should be used in making such connections. Any connection should be checked for leaks before the heating appliance is used. A leaking connection may cause an explosion of either manufactured or natural gas, and where manufactured gas is used the additional hazard of carbon monoxide poisoning is created because most manufactured gases contain carbon monoxide.

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House-Heating Furnaces

1. House-heating furnaces for burning any type of fuel must be connected to flues. As a furnace is likely to produce carbon monoxide, it is important that the flue connection be kept in good repair. A badly rusted or flimsy smoke pipe from a furnace is a serious menace to the safety of the entire household. Fatal accidents have been caused by carbon monoxide that escaped from the furnace into the basement and traveled thence through all parts of a house when, unknown to the occupants, a smoke pipe actually had fallen apart.

2. Before furnaces of the hot-air type are put into operation, the interior of the firepot and smoke dome should be examined for cracks or other defects. Such defects will allow carbon monoxide and other products of combustion to enter the hot-air stream and be circulated throughout the interior of the building.

3. Furnace or stove dampers should be set so that all draft cannot be shut off in the flue connections; otherwise products of combustion will escape into the interior of the building through openings in the firedoor instead of taking their intended course through the flue. If there is any question as to the setting or operating condition of furnace dampers, a competent furnace repairman should be consulted.

Water Heaters

1. Water heaters of any type should be fitted with flue connections as a safeguard against carbon monoxide. Some building codes and municipal ordinances do not require that this be done with all types of water heaters, but a householder will be taking the safe course if he has flues installed for any type of water-heating equipment.

Gas Cooking Ranges

1. The kitchen stove may be a source of carbon monoxide. The oven of the stove should have a flue connection. Devices sold for attachment to the oven flue outlet, and advertised as being for the purpose of "replacing the stovepipe," may be more decorative than the old-fashioned stovepipe but can in no way compete with it as a means of removing gas fumes from the kitchen.

2. The top burners of a kitchen range may produce carbon monoxide, particularly when the flame is turned up high under a cold cooking utensil, as the cold metal chills the flame and causes incomplete combustion. Plenty of ventilation in the kitchen, or an exhaust hood over the entire stove, are the best safeguards against carbon monoxide from top burners. These burners should be inspected frequently for accumulations of dust in the air-inlet ports, and adjusted for complete combustion as previously described in item (3), under Gas-fired Space Heaters.

3. Where manufactured gas is used, accidents have occurred when an unwatched cooking utensil boiled over and extinguished the flame, allowing the unburned gas to escape. As most manufactured gases contain carbon monoxide,

dangerous quantities of this gas can accumulate in a room in a short time as a result of such a common occurrence as the boiling over of a coffeepot.

Leaks in Gas Lines

1. The most serious hazard from leaks in pipes carrying natural gas is the danger of explosion. If there is any indication that a line is leaking, repairs should be made at once. Exposed piping and fittings may be tested for leaks by applying thick soapsuds. The formation of expanding bubbles shows the location of a leak. In many localities unpleasant-smelling materials are added to fuel gas so that the odor will give warning of leaks in gas lines. Any householder noticing such odors should investigate at once and have necessary repairs made.

2. In addition to the hazard of explosion, leaks in pipelines carrying manufactured gas also are a source of danger from carbon monoxide.

Operation of Automobile Engines in Garages

Repeated warnings have been issued to the public as to the extreme danger of operating automobile engines in closed garages, but accidents continue to happen from this practice. Running an automobile engine for only 2 or 3 minutes in a closed garage will produce a very dangerous concentration of carbon monoxide in the air of the garage. This is particularly true in cold weather when the choke is used in starting the engine, as more carbon monoxide will be produced than when the engine is "warmed up." Make it a habit never to turn on the ignition or to use the starter unless the garage doors are opened wide.

TREATMENT OF CARBON MONOXIDE POISONING

Persons who have been overcome or otherwise affected by carbon monoxide should be treated in the following manner:

1. Remove the victim to fresh air. The rescuer must take care that he, too, is not overcome while making the rescue. Ventilate the room where the accident occurred. Turn off all gas appliances.

2. If the victim has stopped breathing, administer artificial respiration until he is breathing naturally or until he is declared dead by a doctor. If possible, use an inhalator to administer oxygen. Many fire departments and public utilities companies maintain inhalators and rescue crews for such emergencies. However, do not wait for help - begin artificial respiration as soon as the victim is removed to fresh air.

3. Call a doctor.

4. Keep the patient warm.

5. Keep the patient quite (lying down).

SUMMARY

Pertinent points in the foregoing discussion of the possible dangers from carbon monoxide in the home are repeated to stress their importance:

What To Do - Suggestions for the Safe Use of Household Heating Appliances

1. Vent with flue connections all gas-fired heating appliances.
2. Always have ventilation in rooms where gas-heating appliances are burning.
3. Adjust gas burners properly.
4. Keep smoke pipes and flues of house-heating furnaces in good repair.
5. Inspect the firepot and smoke dome of hot-air furnaces for cracks or other defects.
6. Vent with flue connections the ovens of gas-cooking stoves.
7. Always have ventilation in the kitchen when using the gas range.
8. Guard against accidental extinguishment of the flames and escape of unburned gas in any heating or cooking appliance.
9. Be sure there are no leaks in gas pipes.

What Not To Do - Precautions Against Unsafe Practices That May Lead to Accidents From Carbon Monoxide

1. Do not operate gas-heating appliances at excessively high rates of burning.
2. Do not retire for the night with a gas-heating appliance burning in the bedroom.
3. Do not burn manufactured gas in a stove designed for natural gas, and vice versa.
4. Do not use rubber hose to connect heating appliances to gas-service lines.
5. Do not set furnace or stove dampers so that draft is shut off entirely in the flue.
6. Never operate an automobile engine in a garage with the garage doors closed.